(1) 12 Points. If the random variable $X$ has a normal distribution with mean $\mu = 82.21$ and variance $\sigma^2 = 47.85$, find

(a) $\text{Prob}(80.00 \leq X \leq 100.00)$  
(b) $x_{0.12}$

(2) 12 Points. If the random variable $W$ has a $\chi^2$-distribution with 33 degrees of freedom, find

(a) $\text{Prob}(30.00 \leq W \leq 50.00)$  
(b) $w_{0.0032}$

(3) 12 Points. A research scientist reports that mice will live an average of 42.50 months when their diets are sharply restricted and then enriched with vitamins and proteins. Assuming that the lifetimes of such mice are normally distributed with a standard deviation of 6.77 months, find the probability that a given mouse subjected to this treatment will live less than 32.00 months.

(4) 12 Points. A homeowner plants 10 flower bulbs at random from a box containing 25 tulip bulbs, 15 daffodil bulbs and 20 crocus bulbs. What is the probability that the homeowner has planted 5 tulip bulbs, 2 daffodil bulbs and 3 crocus bulbs?

(5) 12 Points. Suppose that you throw 2 dice simultaneously until you throw a six on both dice. Find the probability that you will need to throw the pair of dice at least 12 times before this happens.

(6) 12 Points. (a) Give the density function for the continuous uniform distribution on the interval $[0, \sqrt{39}]$.

(b) Find exact values, rather than decimal approximations, for the mean and the standard deviation for the continuous uniform distribution on the interval $[0, \sqrt{39}]$.

(7) 16 Points. The life in years of a certain type of electrical switch has an exponential distribution with an average life of $\beta = 18.50$ years.

(a) Find the probability $p$ that one of these switches will fail in the first 10 years of use.

(b) If 80 of these switches are installed in different systems, what is the probability that at most 25 of the switches fail during the first 10 years?

(8) 12 Points. Let $X$ be the number of automobile accidents that occur in one year on the Poplar Street bridge. Write a brief essay in which you argue either that the variable $X$ does have a Poisson distribution or else that $X$ does not have a Poisson distribution. Support your argument by explaining how the assumptions for the Poisson distribution are satisfied or are violated.